

CONJUGATE FIELD APPROACHES FOR ACTIVE
ARRAY COMPENSATION

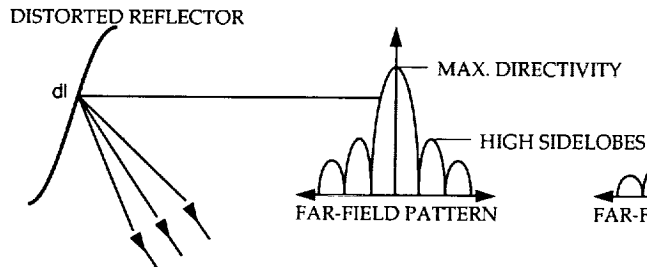
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CONJUGATE FIELD APPROACHES FOR ACTIVE ARRAY COMPENSATION

Two approaches for calculating the compensating feed array complex excitations are namely, the indirect conjugate field matching (ICFM) and the direct conjugate field matching (DCFM) approach. (Ref 1.). In the ICFM approach the compensating feed array excitations are determined by considering the transmitting mode and the reciprocity principle. The DCFM "in contrast" calculates the array excitations by integrating directly the induced surface currents on the reflector under a receiving mode. DCFM allows the reflector to be illuminated by an incident plane wave with a tapered amplitude. The level of taper can effectively control the sidelobe level of the compensated antenna pattern.

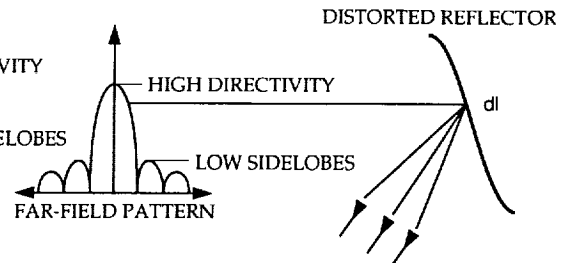
INDIRECT CONJUGATE FIELD MATCHING (ICFM)



ICFM FEATURES

- RECIPROCITY APPLIES (TRANSMITTING CODES)
- MAXIMUM DIRECTIVITY IS ACHIEVABLE

DIRECT CONJUGATE FIELD MATCHING (DCFM)

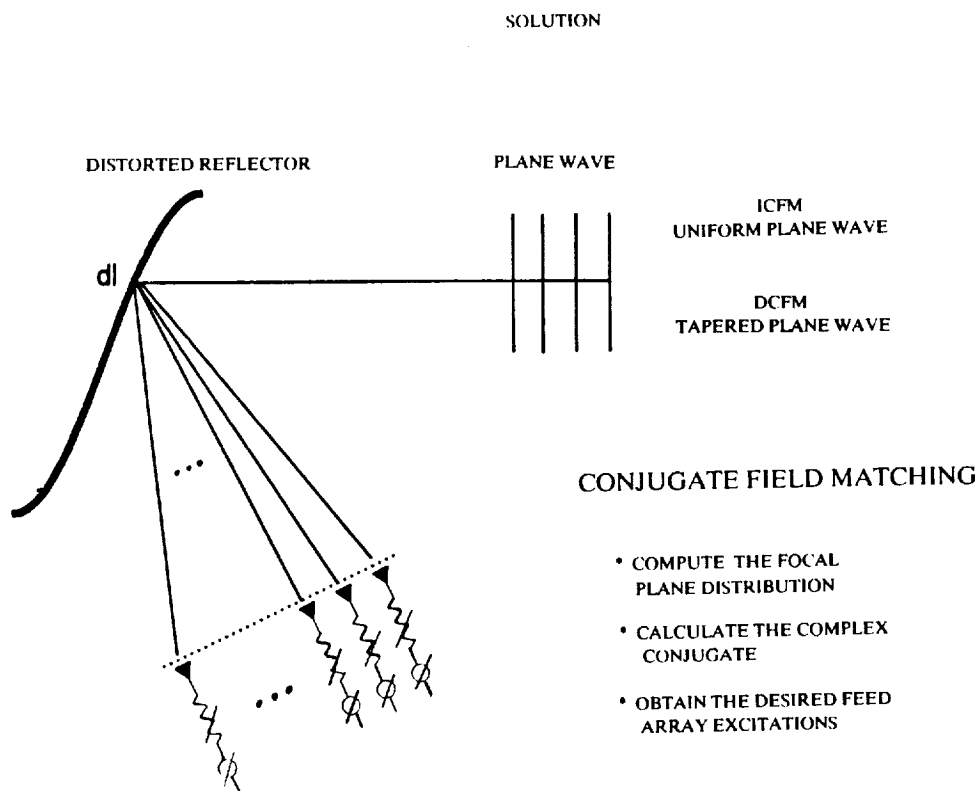


DCFM FEATURES

- DIRECT CONTROL OF SIDELOBES
- DIRECTIVITY WITHIN 2DB OF MAXIMUM
- EASY TO IMPLEMENT

CONJUGATE FIELD MATCHING PRINCIPLE

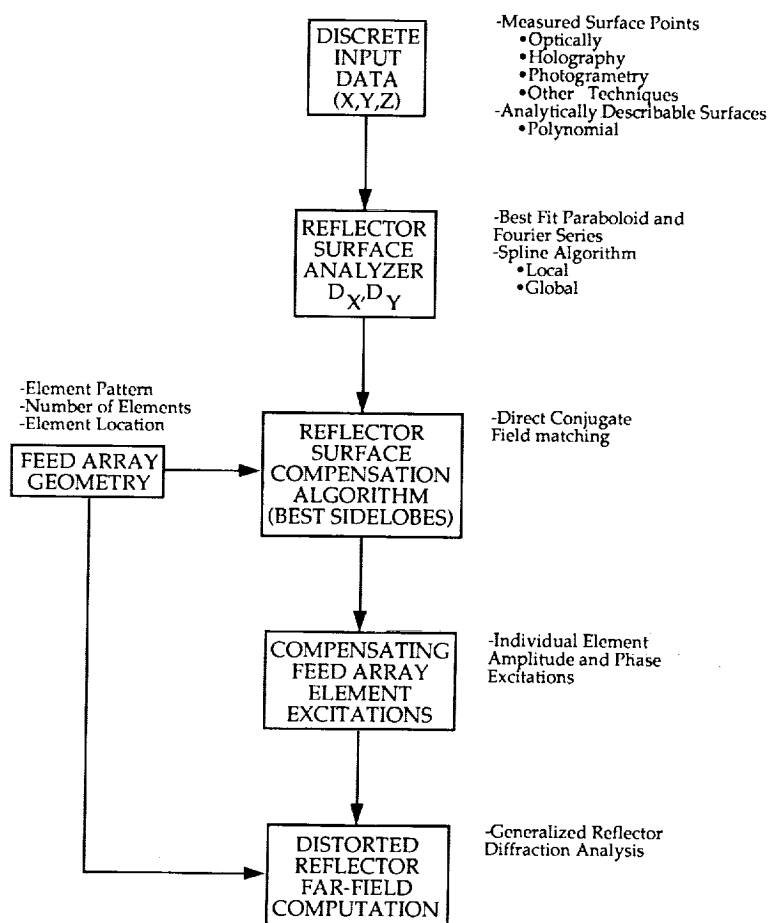
The DCFM approach is based on the receiving antenna mode, as outlined below. Let the distorted antenna be illuminated by an incident plane wave from a prescribed direction and with a prescribed polarization. That direction and polarization are those of the main beam when the antenna is in the transmitting mode. The plane wave has a planar phase front as in an ordinary plane wave case, but with the option of having a uniform amplitude (ICFM) or a tapered amplitude (DCFM). Using this concept, the resulting fields in the focal plane of the reflector antenna can be calculated by integrating the induced current distribution on the distorted reflector surface. The set of excitation coefficients of the compensating feed array is obtained as complex conjugate of the received focal plane electric field distribution.



ASSUMPTION: REFLECTOR DISTORTION KNOWN

DIRECT CONJUGATE FIELD MATCHING COMPUTER IMPLEMENTATION

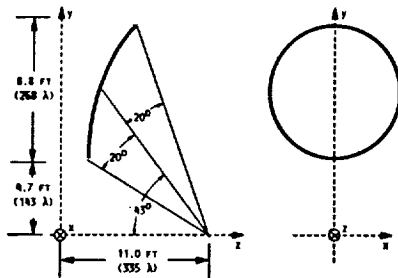
A block diagram of a numerical implementation for the DCFM approach is illustrated below. It determines the focal plane electric field distribution due to a tapered plane wave incident on the distorted reflector from a known observation direction. The algorithm uses physical optics technique for obtaining the focal region fields. The compensating feed array are obtained by assigning the complex conjugate values of the focal region fields at the corresponding feed element location. Basically, two inputs are to be defined, the feed array geometry and the distorted reflector surface points.



EXAMPLE OF CALCULATION

Let us consider the undistorted offset parabolic geometry and surface error profile illustrated in the figure below. Also presented in the figure are the feed parameters and the undistorted E-plane radiation pattern obtained by placing a single feed at the focal point.

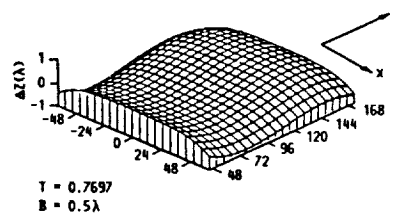
PROBLEM DESCRIPTION



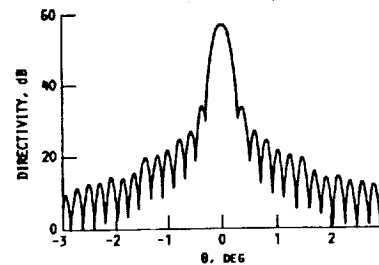
UNDISTORTED ANTENNA GEOMETRY

OPERATING FREQUENCY, GHz	30
FEED POLARIZATION	LINEAR
E-PLANE PATTERN $\cos^{QE}(\theta)$	$QE = 20$
H-PLANE PATTERN $\cos^{QH}(\theta)$	$QH = 20$
FEED LOCATION (FOCUS), METERS	(0.0, 3.35)
EDGE TAPER, dB	-11

SUMMARY OF FEED PARAMETERS



SURFACE DISTORTION PROFILE

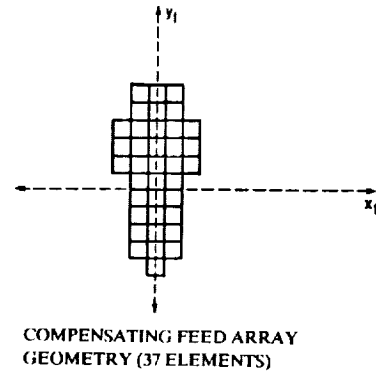
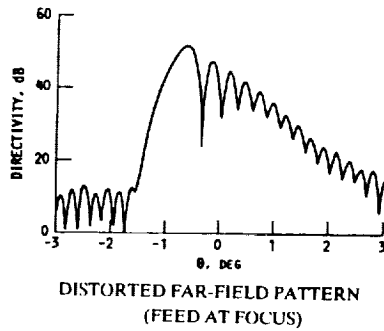


UNDISTORTED FAR FIELD PATTERN

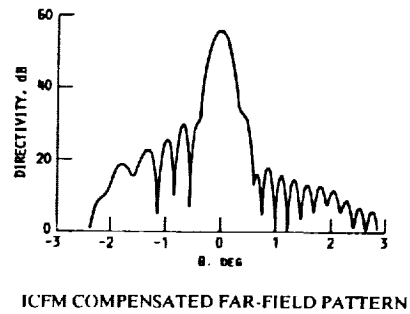
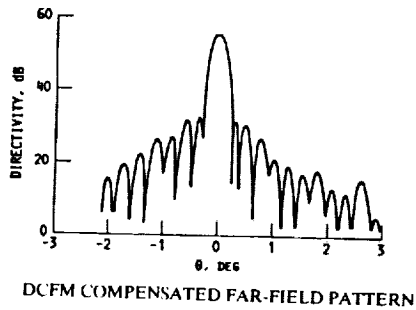
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RESULTS

The figure below presents the distorted far-field, compensated far-field of DCFM solution, compensated far-field of ICFM solution and the compensating feed array geometry. The ICFM approach assumes a uniform plane wave incident on the distorted reflector. The compensated directivity for both approaches was within 2 DB of the undistorted value. The major differences occurred in the compensated sidelobe level envelope. Note that the sidelobe level for the DCFM approach was 3 to 5 DB lower than those produced by the ICFM approach. This result indicates that the amplitude tapering of the incident plane wave has a direct control over the compensated sidelobe envelope.



RESULTS



REFERENCE

1. Acosta, R. : Active Feed Array Compensation for Reflector Antenna Surface Distortion.
NASA TM 100826, June 1986.

